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CONTROL OF LATE BLIGHT OF TOMATOES IN FLORIDA

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Late blight of tomatoes, caused by the fungus *Phytophthora infestans* (Mont.) DBy., has been known for many years. In the fall of 1945 this disease appeared in severe, epidemic form in some Florida tomatoes. Since that season it has been the cause of serious losses, estimated at hundreds of thousands of dollars annually, to growers throughout the state. In the 1947 season it caused many complete crop failures. The rapidity with which the disease spreads and its destructiveness make its control mandatory if tomatoes are to be grown at a profit.

The late blight fungus has long been known to thrive in cool, damp weather. The long, cool nights of the winter growing season, usually attendant with heavy dews and ground fogs, and the relatively short days with mild temperatures are favorable for late blight development. These conditions occur frequently in the major tomato growing areas of Florida from November 1 to March 15.

All the above-ground parts of the tomato are subject to attack by the late blight fungus. Plants are attacked at all ages in both seedbed and field. Spores are produced in great numbers in diseased areas on fruits, stems and leaves. These spores are carried by splashing rain, wind or other agencies. Observations indicate that the wind may carry living spores many miles. New infections are started if they reach other tomato or potato plants. Spore germination is most rapid at temperatures of 40 to 60° F. While rapid development of the fungus in diseased tissues occurs between 70 to 80° F., it will continue to develop slowly at higher temperatures. The usual time required to complete the life cycle of the fungus from spore to spore is from three to five days.

Cultural Recommendations

There are several cultural recommendations that will aid in the control of late blight. These procedures make disease control easier, but will **not**, in themselves, control late blight.

The problem of preventing or controlling late blight is much less difficult on staked and pruned tomatoes than on unstaked and unpruned plants. Staked and pruned plants usually dry more quickly after dew or rain and complete spray coverage can be attained on full-grown staked plants but is very difficult on a heavy growth of vines on the ground. Many growers who operate under conditions that seem to prohibit staking might

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find it profitable to prune their plants to two branches before the vines begin to fall over.

A wide spacing of plants in unstaked fields will promote better air drainage and better spray coverage. Similarly, seedbeds which are drilled thinly in rows will be more easily handled from a late blight standpoint than beds thickly broadcast.

When seedbeds have served to supply the plants needed for transplanting they should be destroyed immediately. This also applies to plants in abandoned fields. Such a proceduce is most effective on a community-wide basis, since even one old seedbed or field may supply, under favorable conditions, sufficient spores to blanket an entire growing area. This sanitary practice cannot be recommended too highly.

It is not advisable to use any plants from an infected seedbed, since this may result in the introduction of late blight into the field and may lead to a greatly reduced stand.

While none of the weeds present in tomato fields is known to be a host of the late blight fungus, their presence interferes with good spray coverage, increases humidity and hinders air circulation among the plants. It is recommended that fields and seedbeds be as free as possible of weeds.

Control of Late Blight in Seedbeds

Carefully conducted experiments have shown that the disease can be controlled in seedbeds, even under weather conditions most favorable for the rapid development of the fungus. As long as the hazard of late blight is slight, that is, when late blight is not known to be present or when the weather is hot and dry, it is recommended that seedbeds be sprayed with dithane D-14[2] once a week, beginning when the first true leaves appear. This fungicidal spray is prepared according to the following standard formula: dithane D-14, 2 qts.; zinc sulfate, 1 lb.; hydrated lime, ½ lb.; water, 100 gals. The chemicals should be added to the water in the order of mention, preferably under continuous stirring.

Dithane D-14 should not be applied to tomato plants in the seedbed stage more frequently than once a week. Heavy and frequent doses damage young plants, causing stunting and distortion. If late blight appears in the seedbed or develops in nearby plantings and the weather becomes cool and damp, it is recommended that phygon[3] be used as a mid-week spray, alternating with dithane, until the threat subsides. Phygon should be used at the concentration of only ½ to ¾ lb. per 100 gals. of spray. Higher concentrations will injure young plants if excessive quantities are applied.

Effective control of late blight in seedbeds is attainable if these materials are applied with a good knapsack sprayer which provides enough agitation to keep the fungicide in suspension. Complete coverage of all above-ground parts of the plants is necessary, and to this end it is advisable that seedbeds be planted thinly in regularly spaced rows between which the nozzle of the sprayer can be passed easily.

The cool, damp weather conditions most favorable for the

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[2] Disodium ethylene bisdithiocarbamate
[3] 2,3-dichloro-1,4-naphthoquinone

transplanting of tomato seedlings are unfortunately the conditions favoring the rapid development of late blight. If the weather is favorable for late blight and the disease is known to be present in the locality when tomato seedlings are to be transplanted, the plants should be sprayed with dithane or phygon four to 24 hours before being pulled from the seedbed.

Field Control of Late Blight by Spraying

Experimental results and observations made in commercial plantings indicate that late blight can be controlled best by proper spraying begun **before** the plants are diseased. Results of tests to date show that dithane D-14 (same formula as above) controls late blight, even under conditions favorable for rapid blight development. In some tests zinc ethylene bisdithiocarbamate formulations (parzate, dithane Z-78), used at the rate of 2 pounds to 100 gallons of water, have given control approximately equal to that obtained by the dithane D-14-zinc sulfate-lime spray. However, occasional erratic results with these materials do not warrant their general recommendation yet.

These sprays should be applied at five- to seven-day intervals when weather conditions are warm and bright. When blight threatens to be severe, that is, when the fungus is already established in the area and the weather turns cool and damp, the interval should be shortened to four or five days. These fungicides are compatible with insecticides recommended for tomatoes.

The fixed copper fungicides (copper A, tribasic copper sulfate, COCS, cuprocide) and bordeaux mixture are generally less effective. They will control late blight under mild conditions but are not satisfactory under severe conditions. In areas where copper is needed for nutritional purposes, one or two copper sprays can be alternated with the dithane spray if late blight is not threatening at the time.

Whatever the fungicide used, **thorough** coverage of all fruit, stems and leaves is necessary if late blight is to be controlled. This can be accomplished best by a power sprayer equipped with drop booms. When the plants are small, three nozzles per row are sufficient; the number should be increased gradually as the plants enlarge. It is advisable to have from two to four nozzles per row, depending on the size of the plants, located near the ground and directed slightly upwards, in addition to the one to five nozzles per row directed downward. While a working pressure of 400 pounds at the pump usually is sufficient with a small number of nozzles, it may be advisable to increase the pressure as additional nozzles are added. The operator should be **guided by the visible spray residue on the plant** to determine the number of nozzles required, their adjustment, and the amount of spray to be applied to the acre. Spray machines should be checked several times daily to keep the nozzles adjusted and the machine in proper working order. The operator will find it necessary to consider **all** these factors to obtain good coverage.

The materials and methods recommended here are also effective against most of the other foliage diseases of tomatoes, including gray leaf spot (*Stemphylium solani* Weber), which frequently damage tomatoes in Florida.

Field Control by Dusting

Under Florida conditions, dusting for the control of late blight is much less effective than spraying, and the grower should not rely solely on dusting. However, dusting is useful when it is impossible to spray. When dusts have to be used it is recommended that a fixed copper dust containing 7 percent metallic copper be applied at rates of 35 to 40 pounds per acre. Dusts, like sprays, must be applied to all above-ground plant surfaces to be fully effective. The operator should be **guided by the visible residue on both upper and lower leaf surfaces** as an indication of adequacy of cover. Apply dusts when the plants are wet on the time schedule recommended for spraying.

While airplane dusting is generally less effective than ground dusting it should be employed under conditions where spraying or ground dusting cannot be practiced. It offers some protection until spraying can be initiated or resumed.

Recommendations for Home Gardeners

In home gardens, the relatively inefficient knapsack sprayers or hand dusters are generally used. It is important, therefore, that the plants be trained to a single stem on a stake or wire trellis to allow adequate air drainage around the plants and to facilitate good spray coverage. The same precautions concerning proper coverage and timing of spray applications recommended for commercial growers should be observed.

No Resistant Varieties

The terrible late blight epidemic of 1946, which meant a loss of at least $40,000,000 to the tomato growers of the eastern half of the United States, gave increased impetus to efforts to develop varieties resistant to this disease. Since that time there have been numerous rumors that certain varieties and breeding lines show resistance. In certain years some breeding material has shown promise, only to fall victim to the disease in succeeding years. Breeding work is being continued in many places, but at this time there is no prospect that a resistant tomato suitable for commercial production will be available in the near future.

General Recommendations

Before planting, the grower should plan his crop so that he has **adequate machinery and labor to carry out a proper disease control program.** The plant rows should be spaced evenly so that power sprayers can operate efficiently. The grower should limit his acreage to the amount that can reasonably be cared for by his machinery. The writers have observed numerous instances where growers have tried to do too much with too little equipment. As a result, disease control was unsatisfactory. Proper application of fungicides with ground equipment cannot be speeded up, except by providing additional equipment.

Fields should be inspected daily when late blight threatens, so that the operator will know when to shorten the spraying interval. The disease first appears on leaves and stems as water-soaked, irregularly shaped spots which enlarge rapidly. They are greenish brown, usually surrounded by a light green ring. When plants remain wet with dew or rain for several hours, a grayish white downy mold appears on the lower sides of infected leaves and sometimes on their upper surfaces. Supervision of spraying operations and adjustment of sprayers, if it cannot be done by the grower, should be done by a competent individual.